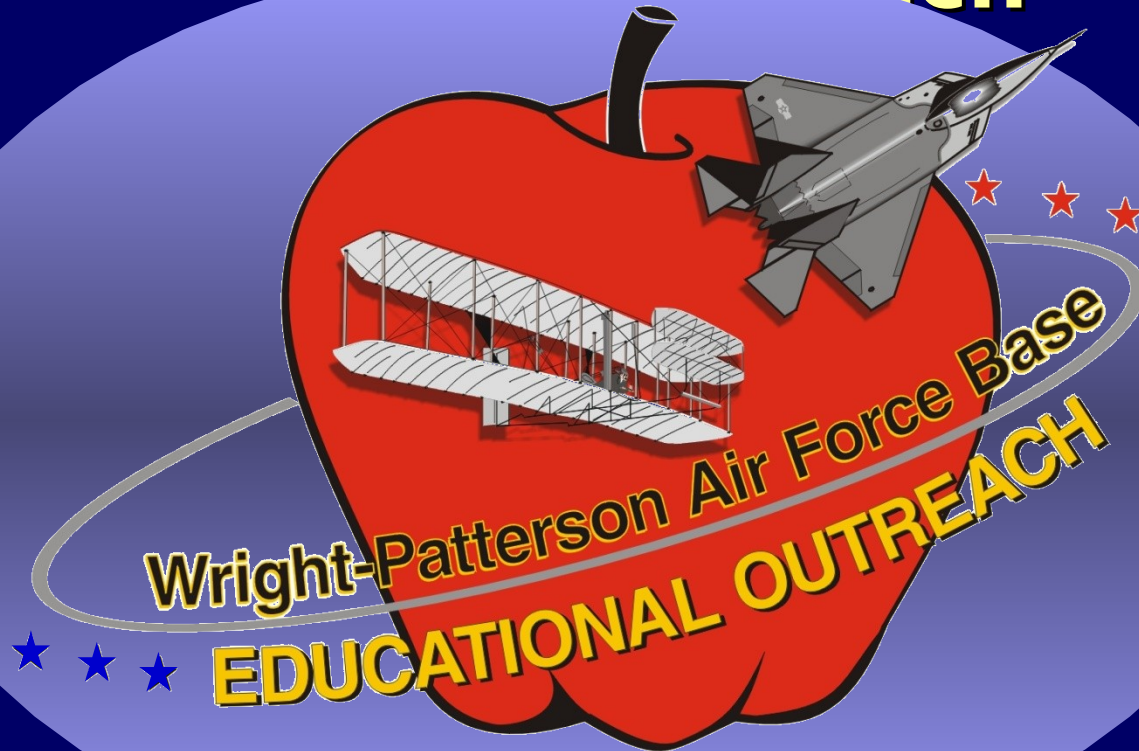


Participating in Science & Engineering Fairs - A Practical Approach



<http://edoutreach.wpafb.>

Bob Gemin
WPAFB Educational Outreach
Engineering
Specialist



**When Somebody
Says “Science
Fair” What’s The
First Thought That
Pops Into Your
Head??**



A Science Fair Is...



If You're A Teacher:

- ▮ A Tool
- ▮ Something To Grade On
- ▮ A Creative Outlet for Students

If You're A Parent:

- ▮ Stressful...it's a PAIN!!
- ▮ Conflicts...Helplessness
- ▮ Potential Source of Pride

If You're A Student

- ▮ A Requirement For A Grade
- ▮ More Work!!
- ▮ Too Many Decisions!!!
- ▮ Fear Of Unknown

What SHOULD You Think Of?



How You Will Feel After Participating In The Science Fair

- ▮ **Pride...Not Relief!**
- ▮ **Rewarded...Not Punished!**
- ▮ **Reward is an Honorable Goal!!**
- ▮ **Motivator Doesn't Always Have To Be Grades!**



***If It Motivates You...
Work for the
Rewards!!!***

***The Important
Results Will Be***

A Science Fair Project Is An Opportunity!!

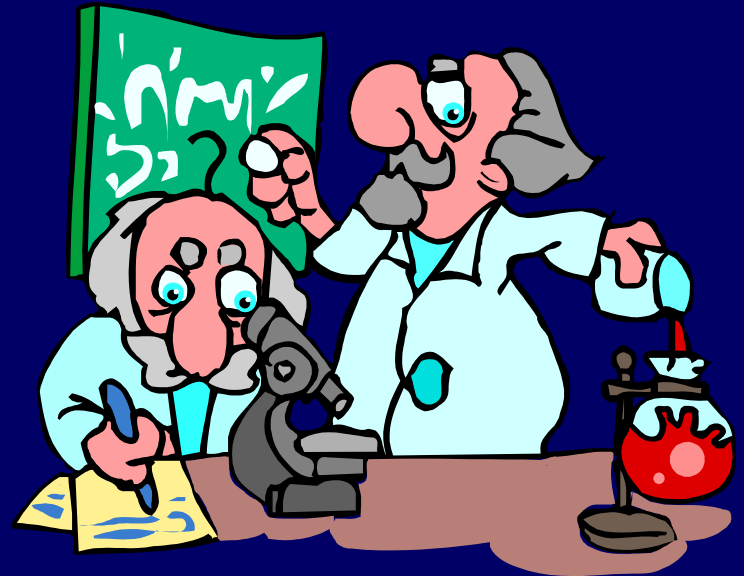


Lots of Awards!

- ▮ Prizes
- ▮ Money
- ▮ Scholarships
- ▮ Summer Jobs
- ▮ Entry Into Select Colleges

By Products:

- ▮ Organization Skills
- ▮ Critical Thinking Skills
 - ▮ Quote Facts, Not Hearsay
- ▮ Presentation Skills
- ▮ Sense of Self



The “Recipe” For A Classic Science Fair



If You’ve Never “Cooked” Before,
There’s A Lot Involved in Baking A
Cake!!



Preparation:

- ▮ Do You Have All The Ingredients You Need?
- ▮ Do You Have All Right Tools?

Process:

- ▮ Follow The Recipe
- ▮ Do Things Step-By-Step
- ▮ Leave the Fancy Stuff to the Chefs!

The Science Fair Recipe



QUESTION

RESEARC

HYPOTHESIS

PROCEDURE

EXPERIMENT

RESULTS

ANALYSIS

CONCLUSION



Scientific Method

Question - Tailor Your Project To You!!



Consider Your

- Interests
- Knowledge Base
- Access to Mentors
- Available Equipment
- Natural Surroundings

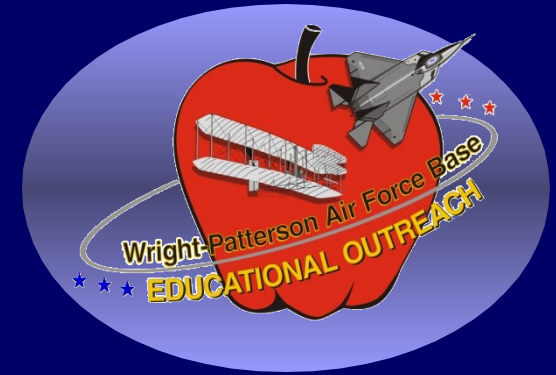
Make A List of Each

- Look For Matches Between Rows



STEP #1 - QUESTION

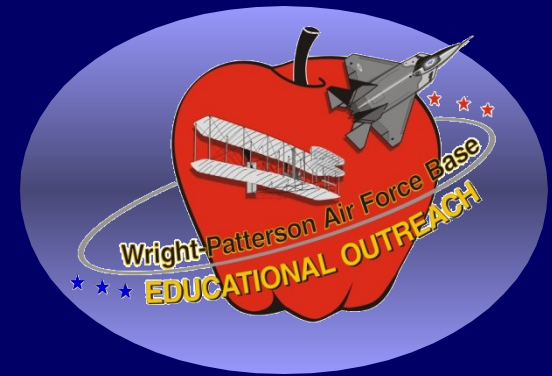
Take A Good Look At Your List!



INTERESTS	KNOWLEDGE/ SKILLS	MENTOR	EQUIPMENT/ SURROUNDIN G
BASKETBALL	MATH	MARY - CHEMISTRY	RULERS
COMPUTER	COMPUTER GAMES	JIM - GARDENING	SCALES (BATH, FOOD, POSTAL)
BUILDING	DRIBBLING BASKETBALL	BOB - ELECTRONICS	THERMOMETERS
LEGOS	BUILDING THINGS	JANE - MECH ENG	FISH TANK
SWIMMING		BETTY - NURSE	BLOOD PRESSURE MONITOR
BIKING		ROY - PAINTER	STOP WATCH
MEDICINE			VIDEO CAMERA
			LEVEL
			RUBBER BANDS
			PRESSURE GAUGES

STEP #1 - QUESTION

I Like Basketball, Roy Has Ladders, I have Pressure Gauges...I Wonder How High a Basketball Will Bounce Under Different Pressures?



INTERESTS	KNOWLEDGE/ SKILLS	MENTOR	EQUIPMENT/ SURROUNDING
BASKETBALL			
COMPUTER	COMPUTER GAMES		SCALES (BATH, FOOD, POSTAL)
	DRIBBLING BASKETBALL		
LEGOS	BUILDING THINGS	JANE - MECH ENG	
		BETTY - NURSE	BLOOD PRESSURE MONITOR
MEDICINE		ROY - PAINTER	PRESSURE GAUGES

STEP #1 - QUESTION

***I Like Computers and Medicine.
I'm Good at Computer Games.
My Friend Betty is a Nurse and
Has a Blood Pressure Monitor.
I Wonder If Playing Computer
Games Raises Your Blood
Pressure?***



INTERESTS	KNOWLEDGE/ SKILLS	MENTOR	EQUIPMENT/ SURROUNDING
BASKETBALL			
COMPUTER	COMPUTER GAMES		SCALES (BATH, FOOD, POSTAL)
	DRIBBLING BASKETBALL		
LEGOS	BUILDING THINGS	JANE - MECH ENG	
		BETTY - NURSE	BLOOD PRESSURE MONITOR
MEDICINE		ROY - PAINTER	PRESSURE GAUGES

STEP #1 - QUESTION

Question - Developing the Best Question For You



▮ Websites To Spark Ideas:

- ▮ <http://www.stemnet.nf.ca/sciencefairs/>
- ▮ <http://www.scifair.org/ideas/index.shtml>
- ▮ http://www.dwusciencefair.com/science_project_links.php3
- ▮ http://madsci.org/MS_search.html
- ▮ <http://youth.net/nsrsc/sci/sci.index.html>
- ▮ <http://iopl.org/div/kidspage/projectguide/projects.html>
- ▮ <http://scitoys.com/>

***Note: This Does NOT Constitute
An Endorsement of These
Websites***

Research – Get A Notebook!



- ▮ **Make A Commitment To Document Your Work**
- ▮ **Research Underlying Scientific Principles:**
 - ▮ **To Help Make Educated Guess To Answer Your Question**
 - ▮ **To Define the Test Design**
- ▮ **Internet Searches Are Great... But Don't Forget Books and People!!**
 - ▮ **More on This Later!!**

Hypothesis



- ▮ **The Hypothesis Rewords Your Question In A Way To Help You Do Your Test**
 - ▮ **Predict the Answer, State Your Reason, If Possible**
 - ▮ **Select Projects With Well Formed Hypothesis**
- ▮ **Special Cases - Engineering Projects**
 - ▮ **Recommendation: Always Have Hypothesis Listed On Poster Board, Regardless of Its Quality**

Hypothesis- Basketball Example:

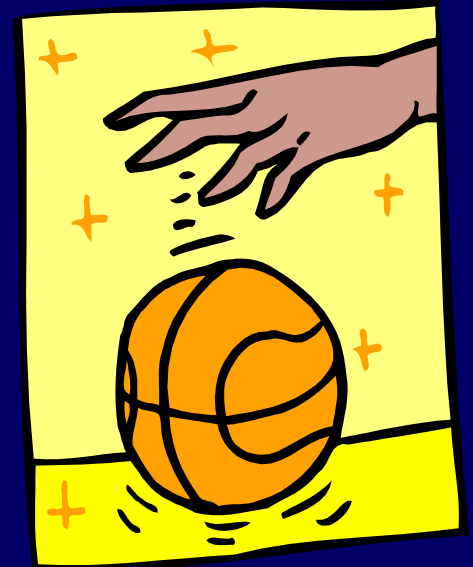


I'm Going to Drop My Basketball With Different Air Pressures... What Do I Think Is Going to Happen?

My Hypothesis: I Expect That My Basketball Will Bounce Higher At Higher Air Pressure

A "Plus" Would Be To Speculate "WHY?"

Then, Start To Visualize Your Graphs That Will Answer Your Question



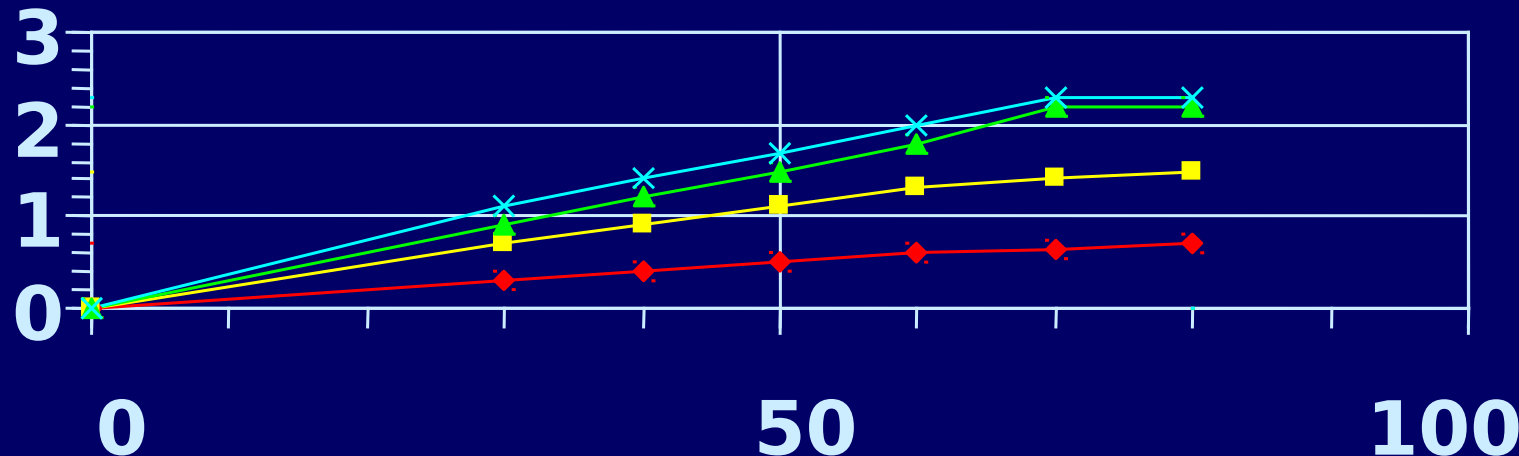
Thinking of Your Ultimate Product, Your Graph, Focuses Your Plan



Bounce Height for Various Basketball Pressures and Drop

1 Meter Height 2 Meter 3 Meter 4 Meter

Bounce Height in Meters



Ball Pressure in Kilopascals

Procedure/Experiment Design Is Critical



- ▮ **Experiments Should Result in Data That Can Be Displayed in a Graph**
 - ▮ **Imagine Steps to Gathering Data to Put Dots on Graph - That is Your Procedure**
 - ▮ **Remember That You Will Need To Record The Data...How Will That Data Arrive?**
 - ▮ **How Long Will Data Point Stay Valid?**
 - ▮ **What Measurement Tools Do You Need?**
 - ▮ **Video Camcorders Can Help Slow Time**

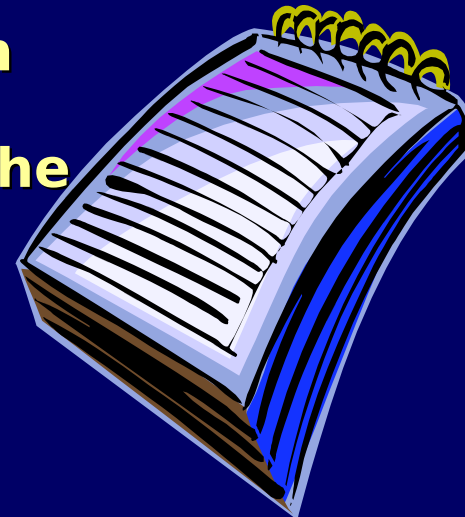
Advice on Gathering Data:



- ▮ **Do A Control Group**
 - ▮ **The ‘NORM” You’ll Compare Your Data To**
 - ▮ **Design and Use Your Own Data Sheet**
 - ▮ **Perform Multiple Data Runs**

- ▮ **Reduce Your Variables**
 - ▮ **Change Only Those That Are Under Test...
Keep EVERYTHING Else The Same**
 - ▮ **Document Anything That Might Have An
Impact (Somebody Opened The
Outside Door and Let Cold Air In...
Bounce of The Ball Changed...)**

The



Sample Data Sheet (Basketball Example)



Ball Pressure _____ Ball Bounce _____

Day _____ Time _____ Temperature _____

Test # _____

Drop Height _____

Test At This Height/Pressure 1 2 3
(Circle)

Rebound Height _____

Observations: (This Could Include Picture
Number, Any Problems Noted (Ball Hit a
Pebble), Etc.)

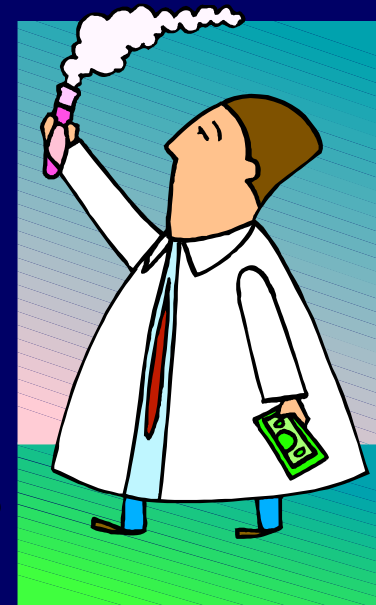
Results - Perform The Experiment



■ The Better You Plan, The Simpler The Test!

■ Record All Testing - Even Failures

- Do A Control Group
- Record All Conditions
- Record Qualitative Data Like Noises/Smells
- Control Your Variables Except What is Under Test
- Record Measuring Tool And Units Of Data
- Label Each Data Run By Time Of Day



STEP #6 - RESULTS

Test Setup, If Possible

Analysis - Have No Fear!!



**You Analyze The Data By
Putting It in the Graph**

- Ask Questions of the Graph...Linear? Slope? Intercept? Maximum? Minimum?**
- Report any Interesting Answers**
- Indicate Reproducibility of Data - Show Multiple Runs on Graphs...or Use Statistics**
- Use Different Graphs to Show Different Features**
- Spreadsheets Are Powerful Tools**
- Don't Be Afraid To change Axis Of Graph! Data Can Be Worked in a Variety of Ways**

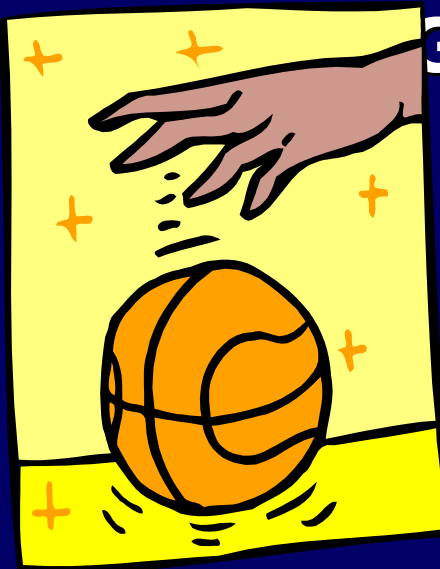


STEP #7 - ANALYSIS

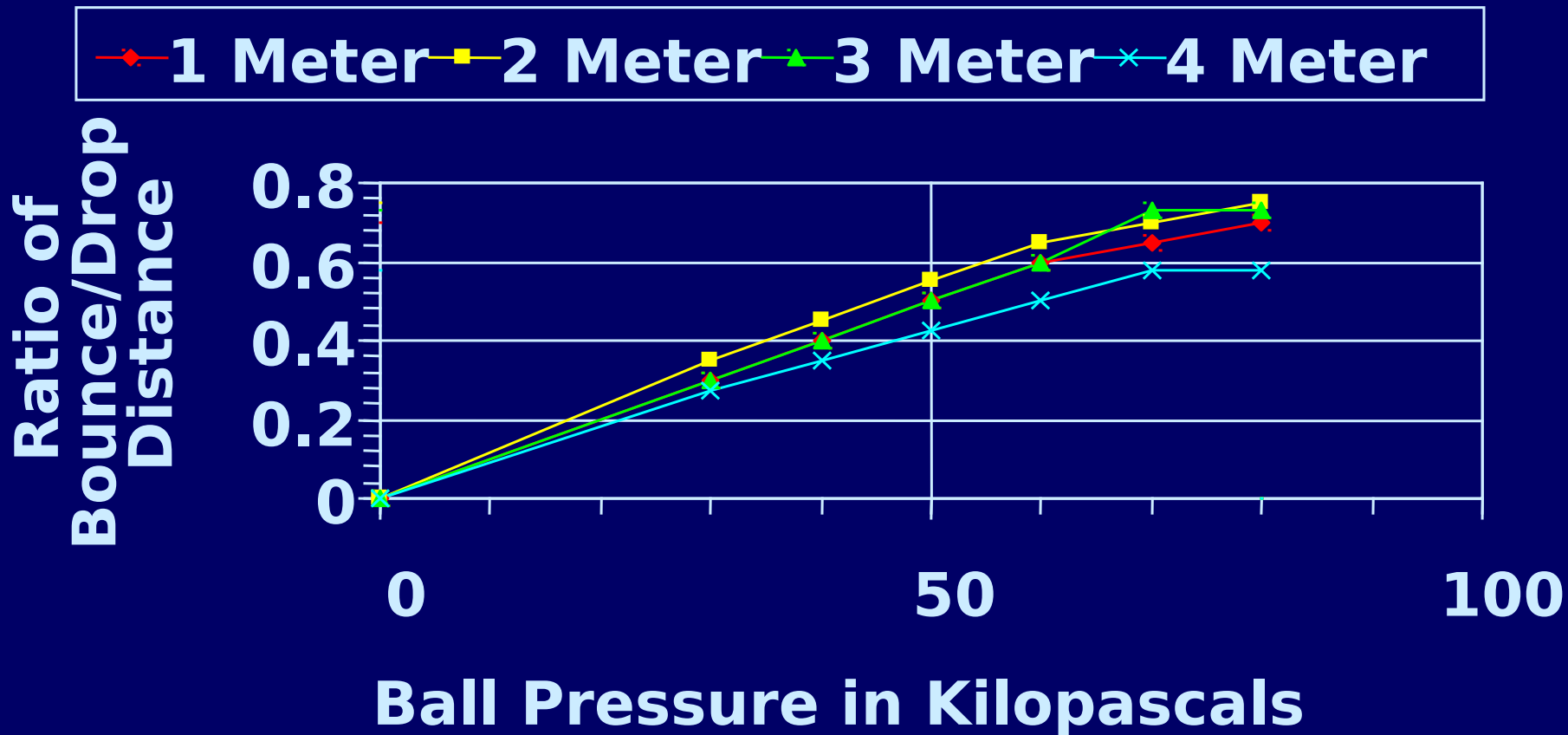
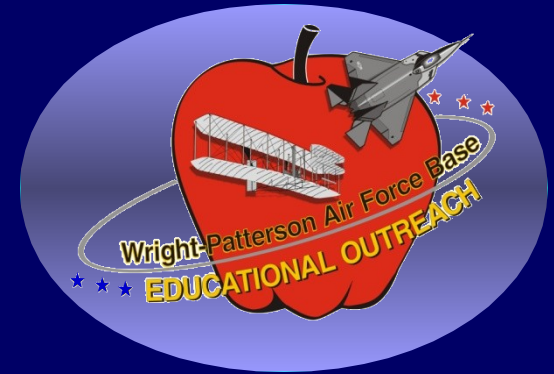
Back To Basketball...



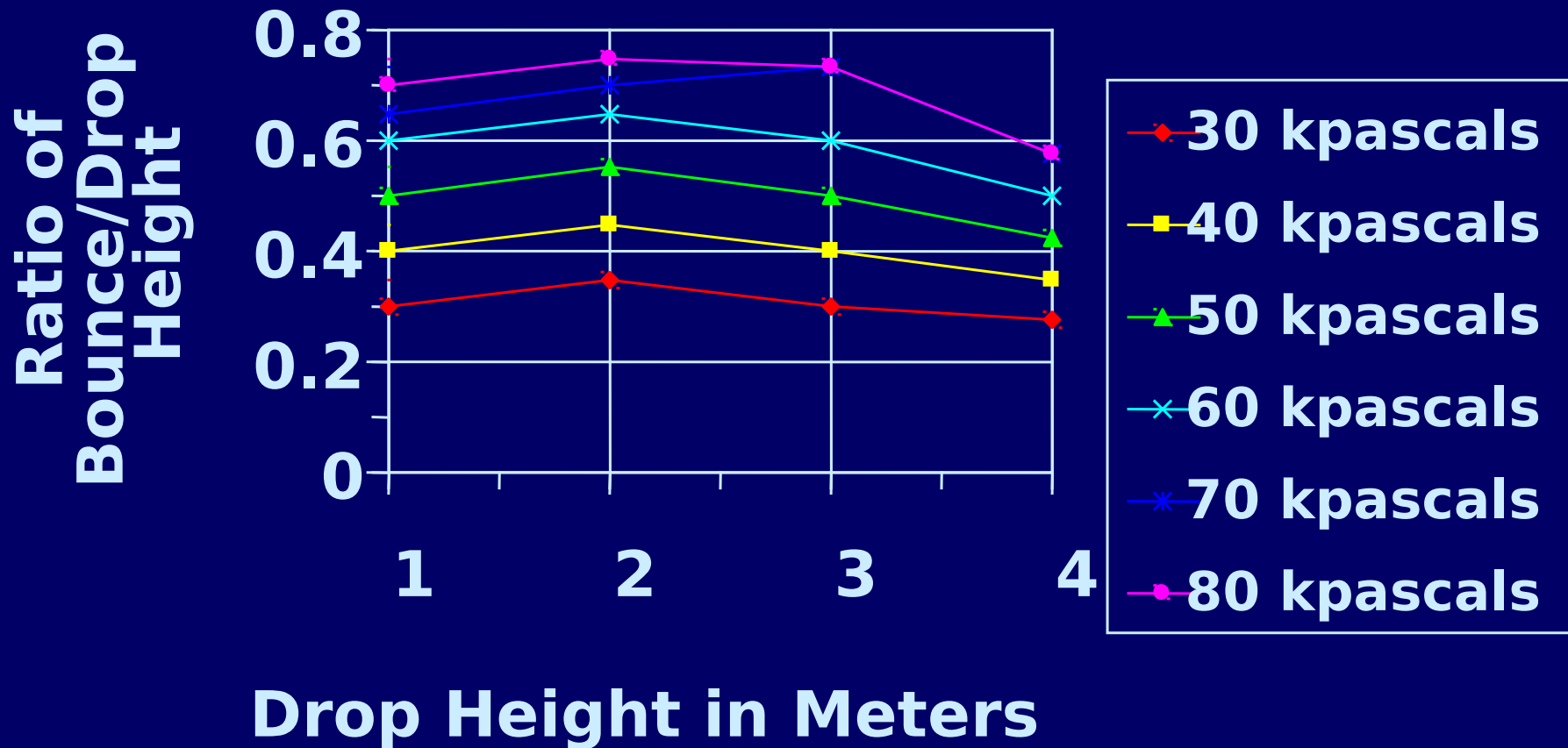
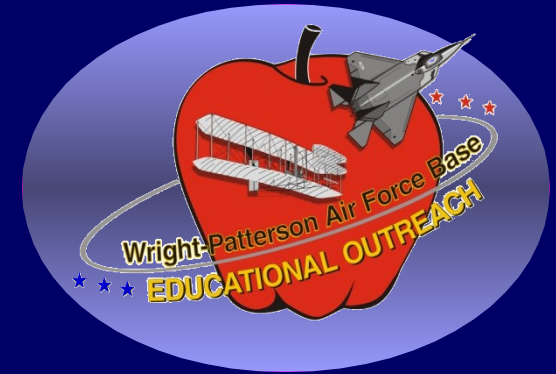
- Here Is Same Data In Two New Graphs Which Results In New Understanding
- This Is An Ex Graphical Analysis



Bounce Ratio Versus Ball Pressure or Various Drop Heights



Bounce Ratio Versus Drop Height For Various Ball Pressures

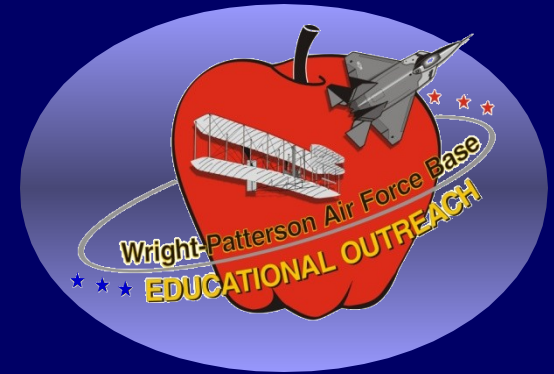


Conclusion



- ▮ **Your Conclusion is a Summary Focused On Answering Your Question/Hypothesis**
 - ▮ **If Your Hypothesis Was Incorrect or Disproved, It is NOT a Failed Experiment!**
 - ▮ **If Your Hypothesis Was Disproved, Offer An Alternative Explanation**
 - ▮ **Always Consider What More Could Be Done**
 - ▮ **Another Test**
 - ▮ **Another Project**

How To Use “PEOPLE” In Your Research:



- You Can Have Numerous Mentors Based On Their Expertise!

- Start With Specific Questions

I'd Be Glad To Assist!!!

- Tell Them What You're Doing and What You Think Will Work

- Ask If You Can Ask Them More Questions

- Scientists and Engineers Love An Occasional Diversion...Like YOU!!

- Many Experts Can Be Found On the Internet

- Make Sure Your Parents Know!



Checklist – What To Ask Yourself and/or Your Mentor



- ☐ **How Do I Analyze?**
 - ☐ **Use A Graph**
 - ☐ **Use Statistics**
- ☐ **How Much Data Should I Take?**
 - ☐ **One Run Is Not Enough!**
 - ☐ **Do At Least Three (3)**
- ☐ **How Do I Define My Experiment?**
 - ☐ **Start With Your Question**
 - ☐ **Envision Graphs That Answer Your Question**
 - ☐ **Envision Collecting Data to Put The “Dots” on the Page**
 - ☐ **Develop Data Sheet**

Prepare For Presentation:



- ▮ **The Focus Should Be Knowledge ... But In A Science Fair IMPRESS THE JUDGES!!**



- ▮ **Anticipate Questions The Judge Will Ask**
- ▮ **Research The Answer**
- ▮ **Make Yourself A Note Card**
- ▮ **Practice Reciting The Answer So It Sounds Natural**

- ▮ **Use your Poster As A Big Note Card**
 - ▮ **Use Topics/Key Words to Stimulate Discussion**
 - ▮ **Don't Forget to Explain Your Graph!!**

NO FEAR!! Practice Your Presentation



- ▮ **Use Flash Cards To Practice
What You Want To Say**

- ▮ **It Helps You With Things
You Should Know Under
Pressure (And Might Not
Remember...)**

- ▮ **Anticipate Questions!**

- ▮ **It Also Adds To Your
Knowledge Base!**



Preparing For The Judges:



- ❑ Expect Questions
- ❑ Have Your Answers Ready For Expected Questions
- ❑ Work Your Answers In If Not Asked
- ❑ Make Sure You Provide Information in Judging Category:
 - ❑ Knowledge Achieved
 - ❑ Originality



Typical Questions:

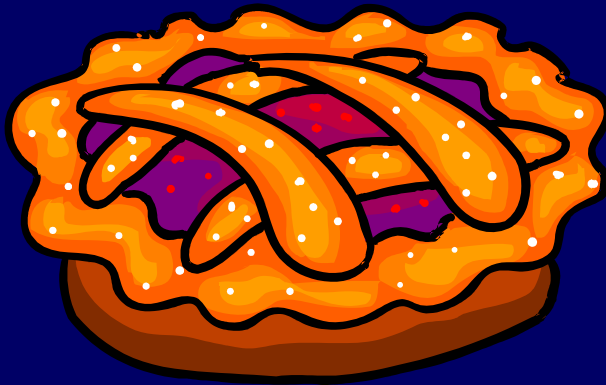


- ▮ **Where did the idea for this project come from?**
- ▮ **What did you learn from your research?**
- ▮ **What were the most important sources used in your research?**
- ▮ **How much time did you spend on the project?
What took most of your time?**
- ▮ **Where did items used in your project come from?**
- ▮ **How many times did you run the experiment on each configuration?**
- ▮ **Did you use any statistics such as averaging?**
- ▮ **How constant were your conditions during experiments?**

Selling Yourself - Use PIE!



- ▮ **Performance**
- ▮ **Image**
- ▮ **Exposure**



- ▮ **Science Fairs Are
A GREAT Time To
Learn How To
Promote Yourself**
- ▮ **Many Successful
People Use PIE
Principle**
- ▮ **“Performance”
Already Covered**
- ▮ **Look At Image
And Exposure...**

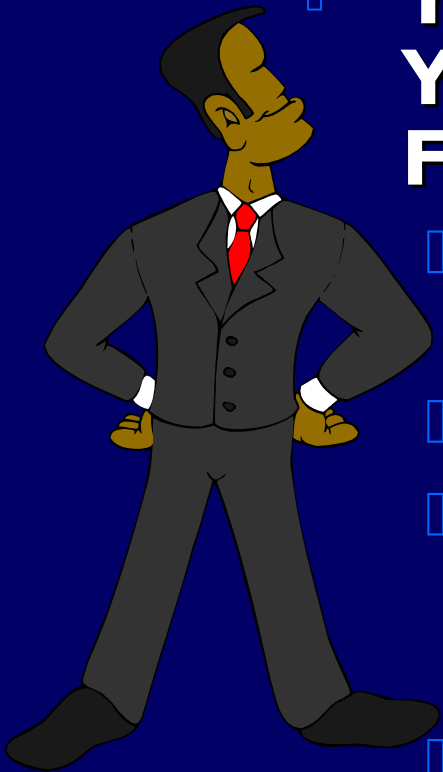
Image -



The Impression You Give in Appearance and Actions:

▮ You Want The Judges To Relate To You And See Their History In YOUR Future!

- ▮ Project The Image Of Being A Budding Scientist Or Engineer
- ▮ Dress Like They Would Dress
- ▮ Show Them You Enjoy What You're Doing...Tell Anecdotal Stories of What Happened, Extra Stuff You Learned
- ▮ Ask Questions
- ▮ Play To Their Expertise...Ask How You Could Do Better In The Next Fair



Exposure -

**Make Sure The
Judges See You and
Remember You:**

- ▮ **Use Attention Grabbing Displays and Posters**
 - ▮ **Check the Rules!!!**
- ▮ **For Maximum “Traffic”, Pick A Project Related To Today’s Public Concerns**
 - ▮ **Understand the Issue, Consider Being an Advocate**
 - ▮ **Examples: Global Warming, Acid Rain, Failed Levies, Pollution, Earthquake Protection, Water Purification, Security Devices, Genetically Altered Foods**

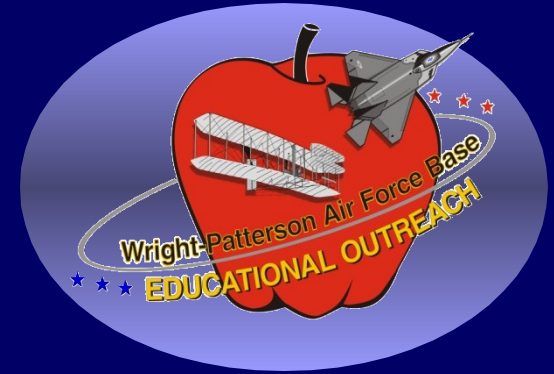


Motivation - Many Opportunities Await!



- ▮ That Future Exceptional Science and/or Engineering Student Can Be You!!
- ▮ Summer Jobs, Free Training, Camps and More Are Available Through Science Fairs!
- ▮ Places To Check:
 - ▮ **Ohio Academy of Science**
<http://www.ohiosci.org/>
 - ▮ **International Science and Engineering Fair... Make Participation in this Fair Your Goal!** <http://www.sciserv.org/isef/>

Motivation - Many Opportunities Await!



More Places To Check Out:

- ▮ **Junior Science and Humanities Symposium**
<http://www.biosciences.utoledo.edu/oishs/index.htm>
- ▮ **Science Talent Search**
<http://www.intel.com/education/sts/>
- ▮ **National Youth Science Camp**
<http://www.sciencecamp.org/>
- ▮ **National Gallery for America's Young Inventors**
<http://www.pafinc.com/gallery/index.htm>

IT REALLY WORKS!!!!

Did We Mention “Having Fun”? :



- ▮ People Throughout History Experimented with Science and Engineering “For Fun”
- ▮ Imagine Getting Paid For Doing Something You Enjoy Doing!!
- ▮ To Avoid Stress:
 - ▮ Start Your Project Early, Be Ready... then Kick Back and Enjoy!!



WELCOME AND ENJOY THE SHOW
HOPE TO SEE YOU



For Additional Information



WPAFB Educational Outreach Office

- ☐ (937) 656-2273
- ☐ (937) 904-8033 fax
- ☐ email: wpafb.educational.outreach@wpafb.af.mil

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**Major
Funding
For the
WPAFB
Education
al
Outreach
Program
Is
Provided
By the Air
Force
Research
Laborator**



te - <http://edoutreach.wpafb.af.mil>

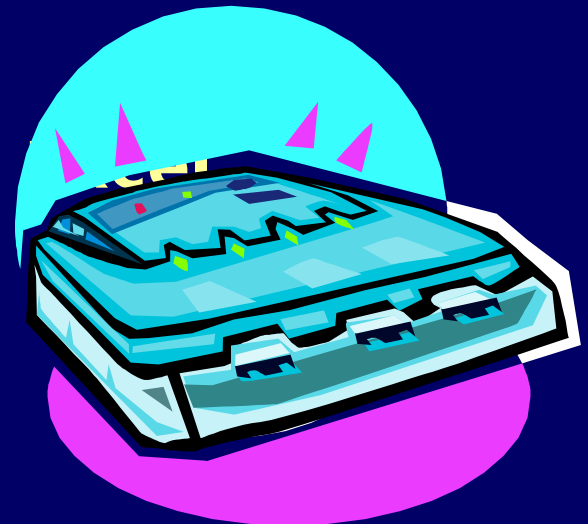
Check Out Our “Scopes For Students” Program!!

**Thanks To A Grant
From The Armed
Forces
Communications and
Electronics
Association We Can
Loan You Specialized
Equipment to Use
With Your Science Fair
Project!!!**



“Scopes For Students”

- **Digital Oscilloscopes Help You Measure A Variety of Parameters In Your Experiment**
- **Measurements are Taken at Small Intervals so You Can Catch What Happens In An Instant!**
- **Data is Recorded in Files That Can Be Analyzed Using MS**
- **Instructions on Equipment Operation Are Provided'**



Types of Sensors:

- **Accelerometers**
- **Barometers**
- **Conductivity Probe**
- **Current Probe**
- **Dual Range Force Sensor**
- **EKG Sensors**
- **Force Plate**
- **Gas Pressure Sensor**
- **Light Sensor**
- **Magnetic Field Sensor**
- **Microphone**
- **pH Sensor**
- **Relative Humidity**
- **Respiration Monitor Belt**
- **Temperature Probes**
- **Thermocouple**
- **UV Sensor**
- **Voltage**